10/551581

JC20 Rec'd PCT/PTO 29 SEP 2005

4/PRTS

DESCRIPTION

# SHEET TRANSPORT MECHANISM

## TECHNICAL FIELD

The present invention relates to a sheet transport mechanism such as provided in image forming apparatuses, that includes a rotation roller, a movable member elastically biased toward the roller, and a sheet transport guide for guiding a sheet to be transported between the rotation roller and the movable member.

## BACKGROUND ART

Conventional image forming apparatuses include a rotation roller for transporting a sheet such as of record paper, and a movable member such as a driven roller or a separation roller. The movable member is elastically biased toward the rotation roller. The rotation roller is rotated, thereby transporting a sheet as fed between the rotation roller and the movable member. Also, a sheet transport guide is provided upstream and/or downstream of the rotation roller in a sheet transport direction. The sheet transport guide guides a sheet between the rotation roller and the movable member. Or, the sheet transport guide guides a sheet which passes through the rotation roller and the movable member, to a next transport

path.

FIG. 4 is a schematic cross-sectional view of a conventional sheet transport guide.

A sheet S is picked up from a sheet feeding section 1 by a sheet feeding roller R1. The sheet S is guided between a separation roller R2 and a separation pad 2. The separation pad 2 is elastically biased toward the separation roller R2 by a spring or the like. The roller R2 corresponds to the rotation roller as described above. When a plurality of sheets S are picked up simultaneously by the roller R1, the sheets S are separated because of differences among respective frictional forces between the separation pad 2 and a bottom one of the sheets S, between the sheets S themselves, and between the separation roller R2 and a top one of the sheets S. Consequently, the sheets S are separated, and fed downstream one at a time. The separation pad 2 pivots according to various thicknesses of sheet S. The separation pad 2 corresponds to the movable member as described above.

After passing between the separation roller R2 and the separation pad 2, a sheet S is guided toward an idle roller pair R3 by a sheet transport guide G which is positioned downstream of the separation roller R2. Then, the sheet S is transported by the idle roller pair R3 to a transfer section where an image is transferred to the sheet S.

The idle roller pair R3 consists of an idle roller R31 and a driven roller R32. The driven roller R32 is elastically biased toward the idle roller R31 and is rotated in association with rotation of the idle roller R31. The driven roller R32 is moved according to various thicknesses of sheet S. The driven roller R32 also corresponds to the movable member as described above. The sheet transport guide G, which includes a sheet of metal or resin material, is positioned upstream of the idle roller R31 so as to guide a sheet S between the idle roller R31 and the driven roller R32.

To avoid interference with movement of the separation pad 2 or the driven roller R32, gaps 4 and 5 of predetermined widths are provided between the sheet transport guide G and the movable member.

Because of a growing need for compact-size apparatus, however, a sheet transport guide is configured so as to guide a sheet along a sheet transport path which has a relatively small radius of curvature. A resulting problem is that a sheet jam occurs with increased frequency because a sheet is more likely to collide with a movable member or with a rotation roller around a gap provided between the sheet transport guide and the movable member. In FIG. 4, a sheet transport path has a particularly small radius of curvature around the gap 5 and, therefore, causes frequent occurrence of sheet jam.

As a solution to the foregoing problem, Japanese Laid-open Patent Application No. H06-092505 discloses a construction in which a sheet is guided by a film member arranged in the vicinity of a pinch roller (a rotation roller). However, the film member has difficulty in guiding a sheet along a sheet transport path which has a small radius of curvature.

A feature of the invention is to offer a sheet transport guide capable of guiding a sheet smoothly even along a sheet transport path which has a small radius of curvature.

## DISCLOSURE OF THE INVENTION

A sheet transport mechanism of the invention includes: a rotation roller; a movable member; and a sheet transport guide for guiding a sheet to be transported toward and/or away from the rotation roller. The sheet transport guide includes an elastic member and has a portion connected to the movable member. The sheet transport guide applies elastic force to the movable member so that the movable member is elastically biased toward the rotation roller.

The elastic member is for example a torsion coil spring having first and second arms for guiding a sheet.

The movable member is for example a driven roller that is rotated in association with rotation of the rotation roller, or a separation pad for feeding one sheet at a time.

A guiding portion such as the arm of the torsion coil spring extends to the movable member that faces the rotation roller, so as to bridge a gap between the arm and the movable member. A sheet is thus transported smoothly. When the elastic member (i.e., the sheet transport guide) is curved according to a radius of curvature of a sheet transport path, the sheet transport guide allows a sheet to be transported more smoothly.

The movable member may be supported by either a coil portion of the torsion coil spring or a first arm of the same.

In the case, a plurality of the movable members are aligned approximately parallel to a shaft of the rotation roller, and the sheet transport guide includes a plurality of the elastic members respectively provided for the movable members.

Thus, a plurality of guides such as the arms of the torsion coil springs are arranged in a width direction of a sheet, i.e., in a direction approximately parallel to the shaft of the rotation roller. When closely spaced, the arms allow stable guidance of a sheet of large width.

It is preferable that a largest elastic force is applied to the movable member positioned at a reference position P0 and that smaller elastic forces are applied to the other movable members at positions distant from the reference position.

A sheet being transported is thus prevented from having

creases thereon when the movable members are the driven rollers. The reference position is located in an approximately central part, or either one of opposite end portions, of the shaft of the rotation roller.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-sectional view of a sheet transport mechanism according to an embodiment of the invention;

FIG. 2A is a schematic front view of the sheet transport mechanism, and FIGs. 2B and 2C are graphs which show spring pressure distribution of torsion coil spring;

FIG. 3 is a schematic cross-sectional view of a sheet transport mechanism according to another embodiment of the invention; and

FIG. 4 is a schematic cross-sectional view of a conventional sheet transport guide.

## THE BEST MODE FOR CARRYING OUT THE INVENTION

With reference to the accompanying drawings, several embodiments of the invention are described below.

FIG. 1 is a schematic cross-sectional view of a sheet transport mechanism according to an embodiment of the invention. FIG. 2A is a schematic front view of the sheet transport

mechanism. FIGs. 2B and 2C are graphs which show spring pressure distribution of a torsion coil spring.

The sheet transport mechanism is applied to a sheet feeding section of an image forming apparatus. The sheet transport mechanism includes a sheet transport guide X. The sheet transport guide X has a plurality of torsion coil springs X. The sheet transport guide X is arranged upstream of an idle roller pair R3 in a sheet transport direction. The idle roller pair R3 consists of an idle roller R31 and driven rollers R32. A sheet S, such as a sheet of record paper, is fed from a sheet feeding section 1 and transported by the idle roller pair R3 to a transfer section 3 where a toner image is transferred to the sheet S.

Each of the torsion coil springs X has a coil portion B1, a first arm B2, and a second arm B4. The coil portion B1 and an end B3 of the arm B2 are fixed to a frame of an image forming apparatus body. An end B5 of the arm B4 supports a rotating shaft of each of the driven rollers R32. Thus, the driven rollers R32 are biased toward the idle roller R31 by elastic forces of the torsion coil springs X. The idle roller R31 corresponds to the rotation roller of the invention. The arm B4 is curved along a path along which the sheet S is transported. The path is hereinafter referred to as a sheet transport path.

A sheet S stored in the sheet feeding section 1 is picked

up by a sheet feeding roller R1. If multiple sheets are picked up simultaneously, the sheets are separated by a separation roller R2 and a separation pad 2 so that only a top sheet is fed. The separation pad 2 is supported by a pivot shaft 2a so as to pivot according to various thicknesses of sheet S.

After passing between the separation roller R2 and the separation pad 2, a sheet S is guided to the idle roller pair R3 by the arm B4.

Since the driven rollers R32 are elastically biased toward the idle roller R31 by the torsion coils X at the respective ends B5, the rollers R32 are caused to pivot according to various thicknesses of sheet S. The rollers R32 correspond to the movable member of the invention.

The arms B4 extend all the way to the respective rollers R32 so as to bridge a gap between the arms B4 and the driven rollers R32, thereby allowing a sheet to be transported smoothly. When the arms B4 are curved according to a radius of curvature of the sheet transport path, the sheet transport guide allows a sheet to be transported more smoothly.

FIG. 2A is a schematic front view of the sheet transport guide X. FIGs. 2B and 2C are graphs which show spring pressure distribution of torsion coil spring. As shown in FIG. 2A, the driven rollers R32 are aligned approximately parallel to a shaft R31a of the idle roller R31. The rollers R32 are provided with

the torsion coil springs X, respectively. The ends B5 of the arms B4 are attached to respective rotation shafts of the driven rollers R32. Stoppers R30 are mounted on the respective rotation shafts in order to prevent the ends B5 from becoming detached from the respective shafts.

Thus, the arms B4 to guide a sheet S (not shown in FIG. 2A) are arranged in a width direction of the sheet S, i.e., in a direction approximately parallel to the shaft R31a of the idle roller R31. When closely spaced, the arms B4 allow stable guidance of a sheet S of large width.

The torsion coil springs X have respective elastic forces (spring pressures) to bias the driven rollers R32 toward the idle roller R31. As shown in FIG. 2B, a largest elastic force is applied to the driven roller R32 at a reference position P0, and smaller elastic forces are applied to the other driven rollers R32 at positions distant from the reference position.

The idle roller R31 thus exerts a transport force on a sheet S in such directions as to smooth out creases on the sheet S (in directions from an approximately central part of the shaft R31a to the opposite ends thereof, in FIG. 2B), so that the sheet S is prevented from having creases thereon.

The elastic forces (spring pressures) of the torsion coil springs X are adjustable by varying opening angle, number of winding turns of the coil portion B1, material and diameter of

wire rod, or the like, of the torsion coil springs X.

The reference position P0 as shown in FIG. 2B is located in the approximately central part of the shaft R31a, and the elastic forces become smaller toward the opposite ends of the shaft R31a. Alternatively, the reference position P0 may be located in either one of end portions of the shaft R31a so that the elastic forces become smaller toward the other end portion of the same. It is to be noted that the reference position P0 is located at such a position where a sheet S of any size necessarily passes.

With reference to FIG. 3, another embodiment of the invention is described below.

FIG. 3 is a schematic cross-sectional view of the sheet transport mechanism of the invention as applied to a sheet guide positioned downstream of the separation roller 2.

The sheet transport mechanism includes a sheet transport guide X1 that has a plurality of torsion coil springs X1. Each of the torsion coil springs X has a coil portion B1', a first arm B2', and a second arm B4'. An end B3' of the arm B2' are fixed to the pivot shaft 2a of the separation pad 2. The pivot shaft 2a is fixed to the frame of the image forming apparatus body. An end B5' of the arm B4' is fixed to a guide 6 that is secured to the apparatus body. The coil portion B1' supports a pivoting end portion of the separation pad 2.

The separation pad 2 is thus biased toward the separation roller R2 by elastic forces of the torsion coil springs X1. In the present embodiment, the separation pad 2 and the separation roller 2 correspond to the movable member and the rotation roller, respectively.

The arm B4' serves as a guide for bridging a gap between the separation pad 2 and the guide 6, thereby allowing a sheet to be transported smoothly.

In the foregoing embodiments, a torsion coil spring is used as an elastic member that serves both as a biasing member for the movable member such as the driven roller or the separation pad and as a guiding member positioned upstream or downstream of the movable member. However, it is to be noted that the elastic member is not limited to the torsion coil spring, but that a member of metal or any material capable of applying a sufficient elastic biasing force suffices as the elastic member.

According to the invention, as described above, the elastic member, such as a torsion coil spring, serves both as the biasing member for biasing the movable member toward the rotation roller and as the guiding member for guiding a sheet toward and away from the rotation roller. A guiding portion of the elastic member, such as the arm of the torsion coil spring, extends to the movable member so as to bridge a gap between the

guiding portion itself and the movable member, thereby allowing smooth guidance of a sheet. Also, when the elastic member is curved according to a radius of curvature of a sheet transport path, the sheet transport guide allows a sheet to be transported more smoothly.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

## INDUSTRIAL APPLICABILITY

The invention is applicable to a sheet feeding section and a sheet ejecting section provided in apparatuses that involve transport and ejection of sheet, such as image forming apparatus, printers, or facsimile machines.